Automatic Safety System for Automobiles

Dr. P. Poongodi
PPG Institute of Technology,
Coimbatore, Tamil Nadu, India

Mr. P. Dineshkumar,
Karpagam University,
Coimbatore, Tamil Nadu, India

***Abstract*— In this paper, the need for safety of vehicles by reducing the impact of crash by applying a smooth or partial braking with the help ARM 11 cortex processor is proposed. The driver's risk of measuring a certain object from a particular distance and failing to notice within the critical limit such conditions are met while designing this work. It is implemented with the LINUX operating system which is highly flexible and compatible when compared to the other operating systems. Once a similar situation is faced the acceleration of the automobile will be directly controlled without disturbing the safe throttle (actual throttle mechanism) of the automobile, the designed machine itself takes the control of acceleration pedal if the brake is not applied within the critical distance. The method is proposed in such a way to be applied to both low cost and existing vehicles as these were already build for the Indian roads.**

Keywords- ARM 11 cortex, Safe throttle, Critical distance, collision warning, linux OS.

I. INTRODUCTION

An automobile has been used to move human beings or objects since the automobile was invented and the automobile technology has been developed within the last few years. Recently, the automobile is thought as daily necessaries because we spend much time in an automobile and enjoy the entertainments available like game, check e-mail, DVD, mp3, and even browsing etc… in the car. Nowadays, the intelligent cars with Adaptive Cruise Control (ACC), Lane Keeping Technology, Auto-Parking System, Tire Pressure Monitoring System (TPMS), and Prevent Pre-crashing System have been equipped because we are in need of a convenient and intelligent car. These new automobile technologies are made possible by the development of semiconductor technology, optical technology and software technology. Nearly 70% of the highway traffic accidents are caused by not keeping braking safety distance between moving cars. The driver makes a mistake by incorrect judgment for braking safety distance is the main reason to cause traffic accident. To ensure safety during driving, every country is building a study on automobile collision and anti collision technology in recent years. The statistics show that in the time of the dangerous situation, if a driver have more than half a second time reaction, it can reduce 45% collision accidents, so the modern cars are equipped with all kinds of measuring and alarm system in order to keep driving safe. Main role in the past and the active systems along with some of the conventional system includes Drive-by-Wires, Automatic Braking Systems (ABS) where developed and this system is called Advance Driver Assistance Systems.

Automatic braking by the system after sensing an obstacle can be executed in two modes. In collision avoidance, the collision is avoided by the automatic braking, but the driver will not be warned in this type of system. There is a very good chance of wrongly interpreting the signals, especially in the case of radars or lasers. So this is not so effective method of automatic braking. In collision mitigation system, the sensors detect the possibility of collision but will not take immediate action. A warning will be sent to the driver in the form of a signal or a voice message. There is a threshold safe distance calculated by the system and if the driver fails to respond even when the vehicle crosses that region, then only brakes will be applied automatically. Even if there is a mis-interpretation of signals, there is no problem because, the decision to apply brakes is left with the driver and the brakes are applied automatically only in the most emergency situations. Many vehicles are provided with the option of turning on or off the automatic system based on their surroundings. In some automobiles even though they cannot be completely disabled, they can be limited to warning the driver about coming obstacle. Even this emergency braking initiates ABS which help the driver to retain the control over vehicle without any skidding. Automatic braking system is only effective if the mode of sensing the obstacles is reliable, or else any kind of false interpretation may cause a lot of damage.

In the Section 2, we discuss the various literature surveys of many authors for the past. In Section 3, we discuss about the proposed system from the literature survey, features of ARM 11 cortex processor, advantages of LINUX over other operating systems and Section 4 describes the conclusion and result of the proposed system.

II. RELATED WORK

"Fabrication of Auto-Braking System for Pre-Crash Safety Using Sensor, "International Journal of Control and Automation Vol. 2, No. 1, March, 2009 by Eung Soo Kim. The Auto-Braking System was designed by VHDL and fabricated to keep a distance between two cars. It provides Pre-Crash Safety System for Intelligent Car. This module can detect the distance between front vehicle and driver's vehicle to keep a constant distance using a sensor and operate the brake system forcibly if the driver does not decrease the speed of car. The system displays the distance between the two vehicles and the speed of your vehicle. The performance of the system was good.

"A Deceleration control method of automobile for collision avoidance based on driver perceptual risk" IEEE international Conference on Intelligent Robots and Systems, Oct 4881-4886

by Takahiro Wada. To reduce rear-end crash of automobiles, it is important to judge necessity of deceleration assistance as earlier as possible and initiate the assistance naturally. On the other hand, we have derived a mathematical model of driver's perceptual risk of proximity in car following situation and successfully derived driver deceleration model to describe deceleration patterns and brake initiation timing of expert driver. In this research, an automatic braking system for collision avoidance will be proposed based on the formulated brake profile model and brake initiation model of expert driver to realize smooth, secure brake assistance naturally. It will be shown that the proposed control method can generate smooth profile for various conditions. In addition, experimental results using a driving simulator will show validity of the proposed system based on subjective evaluation.

"A Theory of Visual Control of Braking Based on Information About Time to Collision", Perception, Vol 5, pp 437-459, by Lee. Collision Warning Systems (CWS) are safety systems designed to warn the driver about an imminent collision. A CWS monitors the dynamic state of the traffic in real time by processing information from various proprioceptive and exteroceptive sensors. It assesses the potential threat level and decides whether a warning should be issued to the driver through auditory and/or visual signals. Several measures have already been defined for threat assessment and various CWS have been proposed in literature. In this paper, we will focus on two time-based measures that assess both front and rear collision threats. In particular, a new threat metric, the time-to-last-second-acceleration (T_{lsa}), for lead vehicles in rear-end collision is proposed and compared with its counterpart, the time-to-last-second-braking (T_{lsb}). The T_{lsa} is a novel time-based approach that focuses on the lead vehicle (as opposed to the following vehicle). It inherits the properties of the T_{lsb} and, as such, is coherent with the human judgment of urgency and severity of threats. It directly quantifies the threat level of the current dynamic situation before a required evasive action (i.e. maximum acceleration) needs to be applied. Furthermore, different warning thresholds are proposed by considering the average driver reaction time. Its effect on decreasing the severity of a rear-end collision is studied and its reliability is tested using a well-established physics-based robotics simulator, namely Webots.

III. Objectives & Overview Of The Proposed Mechanism

A. *Objectives*

From all these literature surveyed papers it is evident that only works related to warning system is given no information on whether braking could be applied in a perfect distance at a faster rate was given. In all the above literatures, the accident prevention is done through various methods like using Rear mounted radar, night vision with pedestrian detection, automatic high-beam control, parental control and GPS vehicle tracking where the implementation cost is very high .The main disadvantage found was the throttle pressure and wheel acceleration was not designed in such a way affecting the travelers or the drivers.

The main objective is to design a system which can apply brakes automatically and smoothly.

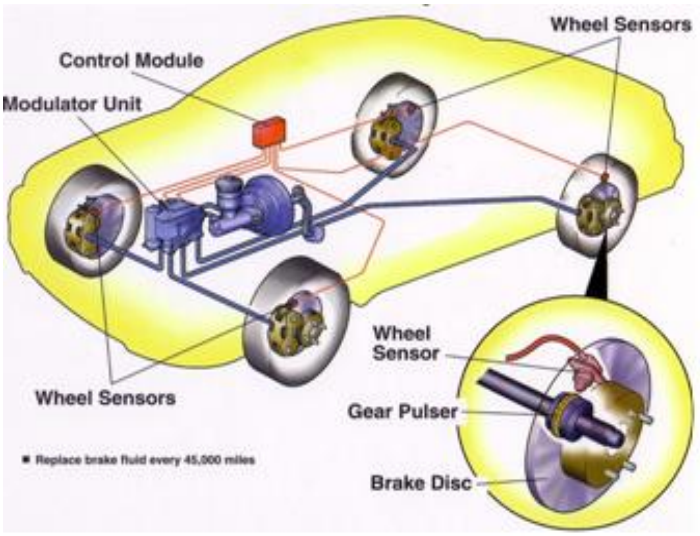

Figure 1. Automatic Braking System

B. *Overview of the Proposed Mechanism*

In this section we present the work done on the basis of reducing the braking speed of the vehicle using collision warning/collision avoidance algorithm.

The processor used is ARM 11 Cortex, which provides a safe and reliable method for controlling. The system needs to be attached to the existing method in which cars are designed so flexibility is a major need. The method is shown in Figure (ii).

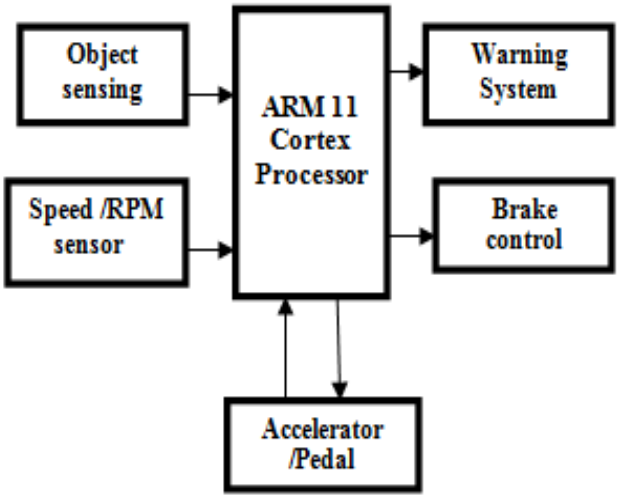

Figure 2. Proposed System

In the Figure (ii), the object sensed using any of the object sensor is given as input along with speed obtained from the RPM counter which will be sent to the processor based on the commands provided it will calculate the speed that's need to be controlled based on the CW/CA algorithm.

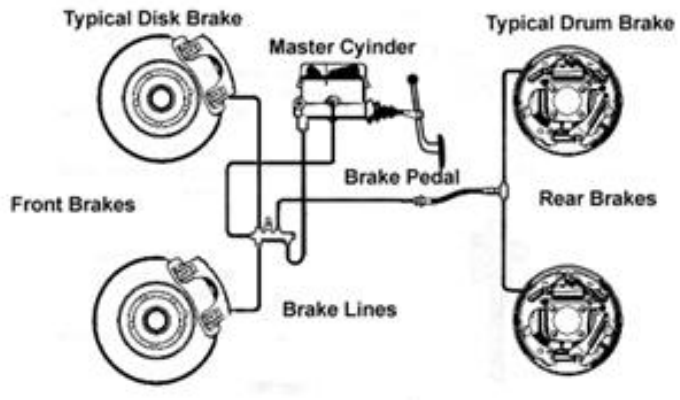

Figure 3. Proposed Automotive Braking System

The above Figure (iii) is the proposed braking method the controlling of the rear brake will adjust the torque of the wheel enabling the system to control the application of brakes.

The speed control will be only applied if the distance is below 45% to collide or else the driver will only have control after he applies the brake. The system will take over if it is too close this will make the brakes and accelerator pedals to be cut from the drivers control and the system will apply the brake and here the algorithm provides a smooth operation of the vehicle and sudden jerks will not be realized.

C. Features of ARM 11 Cortex Processor

ARM Cortex 11is a traditional single core processor for simplified design migration in high-performance, cost-sensitive markets such as mobile handsets and other embedded devices, reducing time-to-market and fully maintaining existing software investments.

The ARM11 processor family provides the engine that powers many Smartphones in production today and is also widely used in consumer, home, and embedded applications. It delivers extreme low power and a range of performance from 350 MHz in small area designs up to 1 GHz in speed-optimized designs in 45 and 65 nm. ARM11 processor software is compatible with all previous generations of ARM processors, and introduces 32-bit SIMD for media processing, physically tagged caches to improve OS context switch performance, Trust Zone for hardware-enforced security, and tightly coupled memories for real-time applications.

D. Advantages of LINUX over other Operating Systems

The most obvious advantage of using Linux is the fact that it is free to obtain, while Microsoft products are available for a hefty and sometimes recurring fee. In line with the costs, the security aspect of Linux is much stronger than that of Windows. The power of choice is a great Linux advantage, we have the power to control just about every aspect of the operating system. Best of all, the vast majority of Linux software is free and open source. We are not only getting the software for no charge, but you have the option to modify the source code and add more features if you understand the programming language.

IV. CONCLUSION

The method was simulated, the results were verified through MATLAB 2009R and the graphs are plotted. Safety and automation is the main trend of future vehicle development. In the future authors believe that safety and warning measurement will be the basic all existing vehicles. The warning and smooth braking system will not only prevent accidents but ensures comfortable travelling at the highways also. When the driver cannot operate the car effectively or vehicle unrestrained or driver doze off, it can help the vehicle slowing down on braking.

V. FUTURE WORK

Further investigation for personal adaptation of braking and control completely by the vehicle even in cities also applying these added values to the already existing vehicles that will not need remodeling will be the future objective of this research work.

REFERENCES

[1] Yuan-Lin Chen, Shun-Chung Wang, Chong-An Wang, “Study on Vehicle Safety Distance Warning System”, Proceedings of the 2007 IEEE.

[2] Yong Chen, Changhua Zhang, “A Novel Vehicle Safety Traffic Pre-warning Decision on Multi-sensor Information Fusion”, 2007 International Conference on Convergence Information Technology

[3] Padmini Kumari J, S.S.Dorle, A.G.Keskar, Megha B.Chakole, ”Micro-controlled based Vehicle Safety System Using Dedicated Short Range Communications (DSRC)”, Second International Conference on Emerging Trends in Engineering and Technology, ICETET-09

[4] Gongliang Jiang , Zhihong Wang, “A Simulation System for Vehicle Safety Operating Speed on the Freeway”, 2010 Ninth International Symposium on Distributed Computing and Applications to Business, Engineering and Science.

[5] Dirk W. Hertel, Edward Chang, *Sensata Technologies, Inc,* “Image Quality Standards in Automotive Vision Applications”, Proceedings of the 2007 IEEE Intelligent Vehicles Symposium, Istanbul, Turkey, June 13-15, 2007

[6] Yihu Wu, Jixiang Xie, Lihu Du & Zhixiang Hou, “Analysis on Traffic Safety Distance of Considering the Deceleration of the Current Vehicle”, 2009 Second International Conference on Intelligent Computation Technology and Automation.

[7] Daxue Liu, Xiangjing An, Zhenping Sun, Hangen He “Active Safety in Autonomous Land Vehicle”, 2008 Workshop on Power Electronics and Intelligent Transportation System.

[8] Susan Y. Chao and Alice M. Agogino, “Optimal Safety Decision Making in Advanced Vehicle Control Systems” Proceedings of the *36th* Conference on Decision & Control, San Diego, Califomia USA December 1997

[9] Lan Huang, Rui Song, “Safety and Reliability Analysis of Automated Vehicle Driving Systems”.